DIRECT TESTIMONY OF

TOM A. BROOKMIRE

ON BEHALF OF

DOMINION ENERGY SOUTH CAROLINA, INC.

DOCKET NO. 2022-2-E

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND CURRENT POSITION.

A. My name is Tom A. Brookmire, and I am the Manager of Nuclear Fuel Procurement at Dominion Energy Services, Inc. My business address is Innsbrook Technical Center, 5000 Dominion Boulevard, Glen Allen, Virginia 23060.

Q. PLEASE BRIEFLY SUMMARIZE YOUR DUTIES WITH DOMINION ENERGY SOUTH CAROLINA, INC.

A. I am responsible for nuclear fuel procurement, fuel-related project management, and nuclear fuel price forecasting and budgeting used by Dominion Energy South Carolina, Inc. ("DESC" or "Company"), which operates in South Carolina.

Q. DESCRIBE YOUR EDUCATIONAL BACKGROUND AND YOUR BUSINESS EXPERIENCE.

A. I am a graduate of Virginia Tech with a Bachelor of Science degree in Nuclear Science (1983), and I received a master's degree in Engineering in Nuclear Engineering from the University of Virginia (1988). I am a registered professional engineer in the Commonwealth of Virginia.

I joined Virginia Electric and Power Company in 1983 and have worked since then in staff and management positions involving nuclear fuel. My current responsibilities include procurement of nuclear fuel and related services, nuclear fuel-related project management, and the projection of nuclear prices and related capital costs and expense rates.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION")?

A. Yes, I have testified before this Commission in Docket No. 2021-2-E. Also, in my capacity as Manager of Nuclear Fuel Procurement, I have testified before the State of North Carolina Utilities Commission and the State Corporation Commission of Virginia on multiple occasions.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to explain the nuclear fuel purchasing process for DESC generation and discuss the prices for conversion services, enrichment services, and fuel fabrication (collectively as "Front End Components") for the Review Period and the near-term outlook.

NUCLEAR FUEL PURCHASING

Q. PLEASE DESCRIBE THE NUCLEAR FUEL CYCLE.

A. Uranium ore is the source of fuel used to generate electricity in nuclear reactors. Naturally occurring uranium primarily consists of two isotopes, 0.7% Uranium-235 ("U-235") and 99.3% Uranium-238 ("U-238"). As depicted in Exhibit No. ___ (TAB-1), uranium must undergo a series of processes to produce a useable fuel before it can be used in a reactor for electricity generation. These processes are mining and milling, conversion, enrichment, and fabrication.

In the first stage, uranium ore is mined. Once the ore is mined, it is sent to a mill where it is crushed into smaller pieces and then introduced to a slurry in which a strong mixed solution is used to dissolve and extract the uranium. The extracted uranium in the form of triuranium octoxide ("U_3O_8") is then filtered and dried to produce uranium concentrates, often referred to as "yellowcake".

Conversion is the next step of the process. There, the yellowcake goes through a chemical process in which it is converted into uranium hexafluoride ("UF_6"). Creating uranium hexafluoride is important because it is the feedstock for the uranium enrichment process.

Enrichment is a highly proprietary isotopic separation process usually conducted with sophisticated machinery. These machines—called centrifuges—increase the percentage of U-235 isotope from 0.7 percent to an amount that is needed to operate in the reactor. Usually, the uranium is enriched to a level between 4% and 5%, but it may not be enriched beyond 5% as Nuclear Regulatory Commission regulations forbid enrichment beyond that point. In some cases, depending on the specific design of a reactor core, uranium may be enriched to a percentage less than the typical 4% to 5% range.

Once the UF_6 is enriched to the desired level, it is shipped to the fuel assembly fabricator. There, the fabricator converts the enriched UF_6 to uranium dioxide ("UO_2") powder which is then formed into pellets. This process, and the subsequent steps of inserting the fuel pellets into fuel rods and bundling the rods into fuel assemblies for use in nuclear reactors, is referred to as fuel assembly fabrication.

Q. PLEASE DESCRIBE HOW YOUR DEPARTMENT MAKES PURCHASING DECISIONS FOR NUCLEAR FUEL.

A. The Nuclear Fuel Procurement ("NFP") group uses the forecasted refueling schedule on a periodic basis to form the foundation for future planned nuclear fuel requirements. Once the nuclear fuel requirements planning is developed, the NFP group is primarily responsible for procuring the uranium and associated services that will, in plan, meet those requirements. When the actual core design is completed, a finalized set of fuel requirements is assembled that forms the basis for the final fuel order.

Q. ARE DESC'S CONTRACTS TO PURCHASE NUCLEAR FUEL NORMALLY SHORT-TERM OR LONG-TERM?

A. Due to the long lead time required to process uranium prior to being loaded in DESC's reactor, the Company's contracts are normally long-term contracts, with a term in excess of two years. Currently the Company has long-term commitments for uranium, conversion services, enrichment, and fabrication for V.C. Summer Unit One. Over the upcoming years the Company anticipates increasing the diversity of supply of uranium, conversion, and enrichment contracts available to DESC as existing legacy contracts expire. During the Review Period, the NFP group monitored the nuclear fuel market on an ongoing basis and evaluated spot market opportunities from time to time that may supplement long-term contract supplies as appropriate. The Company's procurement process also includes uranium inventory, which is designed to provide security of supply for future reactor requirements by mitigating potential market disruptions.

Q. WHAT ARE THE CURRENT MARKET CONDITIONS FOR THE FRONT-END COMPONENTS?

A. The uranium, conversion, and enrichment ("UCE") markets trended downward after the 2011 Japanese earthquake and tsunami impact on the Fukushima nuclear plant. The downward trend lasted approximately five-to-seven years and each of the UCE markets all showed varying decreasing price trends during that time. 2017 effectively marked the post-Fukushima low point for each of the UCE markets, as the market began stabilizing in 2017-2018 and then started trending up. Most market observers anticipate that the uranium and enrichment markets will experience upward price pressures for the remainder of the 2020s.

In the years following Fukushima, there were reductions in the supply of uranium fuel, however, these supply-side reductions generally lagged the demand side reductions (*e.g.*, idling of existing uranium production capacity, postponement and deferral of new mines and mine capacity expansions, idling of a U.S.-based uranium conversion plant, slow attrition of Western world based enrichment capacity, and delays in investment in replacement and/or expansion of Western uranium enrichment capacity). Since 2018, however, the impact of a gradual reduction of excess fuel inventory levels, additional uranium demand from financial entities, and the projected net growth in global reactor demand largely driven by the Chinese nuclear program, market prices for uranium, conversion, and enrichment have increased. Spot and term uranium and enrichment pricing is still well below pre-Fukushima levels, while spot conversion is higher and term conversion is similar to pre-Fukushima levels.

As of January 2022, the spot price for uranium concentrates has more than doubled and term pricing is up about 35% since their respective low points in 2017. However, both spot and term uranium prices are still below prices required for suppliers to restart idled production or commit to initiate new mine production. Kazakhstan remains the largest global uranium production source by far. Recent events there so far are not expected to cause much if any real supply disruption, but may ultimately increase some global utility interest in potential uranium mine restarts and new production.

As of January 2022, the spot price for conversion services has more than tripled and term pricing is up 50% since their respective low points in 2017. The conversion market was particularly oversupplied post Fukushima leading to a shutdown of the single U.S conversion facility, which ultimately resulted in higher pricing and a decision to restart that facility (currently expected to resume operations in 2023). Spot and term conversion prices are now relatively stable and although no additional new Western world conversion capacity will likely be required for many years, current conversion pricing will not support investment in new capacity.

The spot and term enrichment services market pricing hit a low point in mid-2018 and as of January 2022, spot prices are up about 65% and term prices are up about 50%. Current market pricing appears to be adequate for replacement of aging centrifuges to maintain capacity levels required in the mid to latter 2020's, but is well below what would be required for expansion or investment in new capacity. Some of the uplift in term enrichment pricing is possibly due to some increasing interest in long-term enrichment services related to the recent extension of the Russian Suspension Agreement resulting in lower quota levels for Russian supply into the U.S.

The price trend in the U.S. domestic nuclear fuel fabrication continues to be difficult to measure because there is no active spot market, but the consensus is that costs will continue to increase due to regulatory requirements, reduced competition, and new reactor demand both in the U.S. and abroad. Additionally, the parent companies for both U.S. nuclear fuel fabricators (Westinghouse Electric Corporation and Framatome) have experienced financial distress, which is likely to put upward pressure on fabrication costs and nuclear fuel engineering services.

After not restarting any reactors in 2020, Japan restarted three reactors in calendar year 2021. Since 2015, Japan has restarted eight reactors and another 15 are in various stages of approval to restart. Additionally, there are two under construction reactors that have applied to start. The timing and extent of other reactor restarts in Japan currently remains uncertain.

China continues to have an aggressive nuclear energy program and continues to be a significant factor impacting supply and demand for uranium as they do not have significant indigenous sources of uranium. They have acquired or developed significant uranium production capacity outside of China, especially in Africa. China uses its own indigenous sources for conversion and enrichment and is not a significant player impacting global demand outside of China for these services. China currently has 52 reactors in operation, 17 plants under construction, and others in planning.

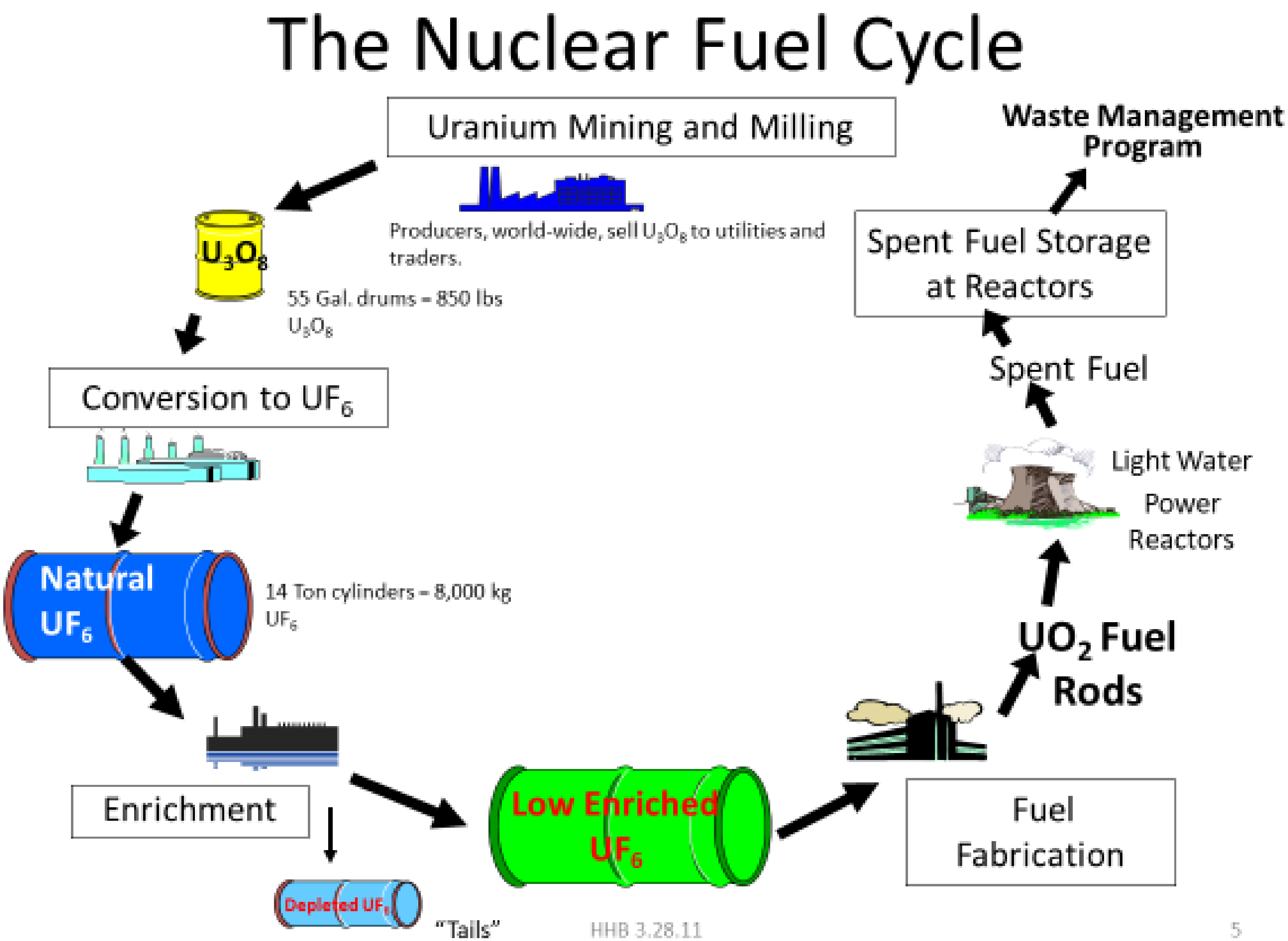
CONCLUSION

Q. WHAT REQUEST DOES THE COMPANY MAKE OF THE COMMISSION IN THIS PROCEEDING?

A. The Nuclear Fuel Procurement group made reasonable and prudent efforts to obtain market-based prices and reliable supply for its nuclear fuel requirements at V.C. Summer Unit 1. Therefore, on behalf of the Company, I respectfully request that the Commission find that the Company's fuel purchasing practices were reasonable and prudent for the Review Period.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.


The Nuclear Fuel Cycle
Uranium Mining and Milling
Waste Management Program
Producers, world-wide, sell U_3O_8 to utilities and traders.
U_3O_8
55 Gal. drums = 850 lbs U_3O_8
Spent Fuel Storage at Reactors
Spent Fuel
Conversion to UF_6
Light Water Power Reactors
Natural UF_6
14 Ton cylinders = 8,000 kg UF_6
UO_2 Fuel Rods
Enrichment
Low Enriched UF_6
Fuel Fabrication
Depleted UF_6
"Tails"
HHB 3.28.11
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